

REMARKS

Rejections Under 35 USC §112, first paragraph

Claim 170 has been rejected under 35 USC 112, first paragraph, as failing to comply with the written description requirement due to the recitation "a thinned semiconductor die having a selected thickness of from 10 μm to 720 μm ".

In response to these rejections, claim 170 has been amended to recite "a thinned semiconductor substrate" in place of "a thinned semiconductor die". The thinned semiconductor substrate 14T is shown in Figure 4C. In addition, page 24, lines 18-20 of the specification (paragraph [0143] of the published application) states:

"the thickness T_s (Fig. 3I) of the thinned substrate 14T is about 6 mils (152 μm). However, the thickness T_s of the thinned substrate 14T can vary from about 10 μm to 720 μm ."

This thickness range is critical because the resultant component can have a reduced thickness relative to a conventional component having a full thickness semiconductor substrate of about 725 μm .

In order to emphasize this aspect of the component, and to further distinguish from the prior art, the thickness range for the thinned substrate has been recited as being from 10 μm to 152 μm . Antecedent basis for this range is contained on page 24, lines 18-20 of the specification (paragraph [0143] of the published application).

Rejections Under 35 USC §103(a)

Claims 170, 172, 173, 175, 176, 178, 263, 265-267 and 270 have been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Bertin et al. (US Patent No. 5,270,261) and *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al.

Claims 171 and 268 have been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Bertin et al. (US Patent No. 5,270,261), *Moisture Absorption in No-Flow Underfill Materials and its Effect on*

Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board by Ferguson et al. and Beffa et al. (US Patent No. 6,233,185).

Claim 176 has been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Bertin et al. (US Patent No. 5,270,261), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and Farnworth et al. (US Patent No. 6,097,087).

Claim 177 has been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Bertin et al. (US Patent No. 5,270,261), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and Farnworth et al. (US Patent No. 6,620,731).

Claim 262 has been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Bertin et al. (US Patent No. 65,270,261), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and Kinsman (US Patent No. 6,717,245).

Claim 269 has been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Bertin et al. (US Patent No. 65,270,261), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and Lin (US Patent No. 5,463,203).

Claim 271 has been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Bertin et al. (US Patent No. 5,270,261), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and *Functional and Smart Materials* by Wang.

Claims 170, 172, 173, 175-178, 263, 265-267 and 270 have been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Grigg et al. (US Patent No. 6,506,681) and *Moisture Absorption in No-Flow Underfill*

Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board by Ferguson et al.

Claims 171 and 268 have been rejected under 35 USC 103(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Grigg et al. (US Patent No. 6,506,681), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and Beffa et al. (US Patent No. 6,233,185).

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Claim 262 has been rejected under 35 USC(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Grigg et al. (US Patent No. 6,506,681), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and Kinsman et al. (US Patent No. 6,717,245).

Claim 269 has been rejected under 35 USC(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Grigg et al. (US Patent No. 6,506,681), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and Lin (US Patent No. 5,436,203).

Claim 271 has been rejected under 35 USC(a) as being obvious over Wakabayashi (US Patent No. 6,607,970) in view of Grigg et al. (US Patent No. 6,506,681), *Moisture Absorption in No-Flow Underfill Materials and its Effect on*

Summary Of Claimed Subject Matter

Claims 170-179 and 262-271 are directed to a semiconductor component 16 (Figures 4A-4C and 1K) which includes a thinned semiconductor die 10T (Figure 4C) having a circuit side 20 (Figure 4C), a thinned back side 22T (Figure 4C), and a plurality of peripheral edges 30 (Figure 4C). The component 16 (Figures 4A-4C) also includes a first polymer layer (circuit side polymer layer 36P (Figure 4C) and edge polymer layers 40 (Figure 4C) covering the circuit side 20 and the edges 30. The component 16 (Figures 4A-4C) also includes a second polymer layer (back side polymer layer 38P (Figure 4C)) covering the back side 22T.

The component 16 (Figures 4A-4C) also includes a plurality of die contacts 18 (Figure 4C) on the die 10T, and a plurality of contact bumps 24P (Figure 4B) on the die contacts 18 embedded in the first polymer layer 36P (Figure 4C). The component 16 (Figures 4A-4C) can also include terminal contacts 42 (Figure 4C) on the contact bumps 24P. As shown in Figure 8F, the component can also include conductive vias 70A (Figure 8F) in electrical communication with the die contacts 18, and terminal contacts 24AP (Figure 8F) on the conductive vias 70A.

35 USC §103(a) Rejections Of Claims 170, 172, 173, 176, 178, 263, 265-267 and 270 Over Wakabayashi, Bertin et al. And Ferguson et al.

The 35 USC §103(a) rejections of claims 170, 172, 173, 176, 178, 263, 265-267 and 270 over Wakabayashi, Bertin et al. and Ferguson et al. are traversed as the rejected claims *taken as a whole* are unobvious over the cited art *taken as a whole*.

Wakabayashi was cited as disclosing a semiconductor component comprising a semiconductor die (1-Figure 10), a plurality of contact bumps (electrodes 6-Figure 10), a first polymer layer (seal film 13-Figure 15) covering the circuit side and edges of the die, and a second polymer layer (seal film 17-Figure 15) covering the back side of the die.

Bertin et al. was cited as disclosing a multi chip package (stack 10-Figure 1) having a thinned chip with a thickness of from 375-425 μm (column 3, lines 16-19).

Ferguson et al. was cited as disclosing a polymer material comprising a self planarizing thermoset underfill film which is rigidifying.

Amended claim 170 is directed to a thinned semiconductor substrate encapsulated and supported on six sides by polymer layers. As stated in amended claim 170 "the first polymer layer and the second polymer layer encapsulating the substrate on six sides and supporting the substrate, the contact bumps and the peripheral edges".

Claim 170 has also been amended to recite a thickness range of from "10 μ m to 152 μ m" for the thinned substrate. Antecedent basis for this recitation is contained on page 24, lines 18-20 of the specification (paragraph [0143] of the published application).

In re Woodruff was cited in the Office Action for the proposition that the claimed range must be shown to be critical and to achieve unexpected results relative to the prior art range. This thickness range is critical because the resultant component can have a reduced thickness relative to a conventional component having a full thickness substrate. In this regard, the substrate at it's upper range is less than a third of thickness of the chip of Bertin et al. (375 μ m). Further, the claimed thickness range achieves unexpected results as a substrate having the claimed thickness range has not heretofore been packaged as a semiconductor component.

The Office Action also cites *In re Rise* for the proposition that a change in size is generally recognized as being within the level of ordinary skill the art. However, this is not the case in semiconductor manufacture, where reduction in size is a primary motivation for research and development. The present component has a reduced size because of a novel fabrication process (Figures 1A-1K) which has been granted US Patent No. 6,908,784. The prior art does not disclose or enable a fabrication process for the present component, which indicates the change in size is not within the level of ordinary skill in the art.

The rejections of claims 170, 172, 173, 176, 178, 263, 265-267 and 270 under 35 USC §103(a) are further traversed as one skilled in the art at the time of the invention would have no reason to combine the references in the manner of the Office Action. Under the criteria established by *KSR Int'l Co., v. Teleflex, Inc.*, No 04-1350 (U.S. Apr. 30, 2007), in formulating rejections under 35 USC §103(a) it remains necessary to

identify a reason why a person of ordinary skill in the art at the time of the invention would have combined references.

With regard to the combination of references the Office Action states: "It would have been obvious to modify the semiconductor Wakabayashi to include a thinned die with a thickness of from 10um to 720 um as disclosed in Bertin because it is a common practice (For Example: See Column 3 Lines 13-19)."

Although thinned dice are known in the art, it is not common practice to encapsulate a thinned substrate on six sides using separate polymer layers to provide a semiconductor component of reduced thickness. Further, the claimed component requires a patented fabrication process (US Patent No. 6,908,784), which is not common practice in the art.

The rejections of claims 175 and 270 are further traversed. In this regard, the characterization of the recitations in claims 175 and 270 as being "product by process" is incorrect as these recitations further define characteristics of the underfill material rather than the method of manufacture as implied by the Office Action. These characteristics are critical because they allow the polymer layers to perform the stated function of encapsulating and supporting the thinned die. As held in In re Garnero, 412 F.2d 276, 279, 162 USPQ 221, 223 (CCPA 1979) holding "interbonded by interfusion" to limit structure of the claimed composite and noting that terms such as "welded", "intermixed", "ground in place", "press fitted", and "etched" are capable of construction as structural limitations.

35 USC §103(a) Rejections Of Claims 171 and 268 Over Wakabayashi, Bertin et al. Ferguson et al. and Beffa et al.

Claims 171 and 268 recite that the thinned substrate comprises "a tested and burned in die". Beffa et al. was cited as disclosing a tested and burned in die.

The 35 USC §103(a) rejections of claims 171 and 268 over Wakabayahsi, Bertin et al., Ferguson et al. and Beffa et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170.

35 USC §103(a) Rejection Of Claim 176 Over Wakabayashi, Bertin et al., Ferguson et al.
And Farnworth et al.

Claim 176 recites a ball grid array for the terminal contacts. Farnworth et al. was cited as disclosing a ball grid array.

The 35 USC §103(a) rejections of claim 176 over Wakabayahsi, Bertin et al., Ferguson et al. and Farnworth et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170.

35 USC §103(a) Rejection Of Claim 177 Over Wakabayashi, Bertin et al., Ferguson et al.
And Farnworth et al.

Claim 177 recites "the substrate includes conductive vias in electrical communication with the die contacts and the contact bumps".

The 35 USC §103(a) rejections of claim 177 over Wakabayahsi, Bertin et al., Ferguson et al. and Farnworth et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170.

These rejections are further traversed because the claimed component *taken as a whole* is unobvious over the art. Although, conductive vias are known in the art they have not heretofore been employed in a thinned substrate encapsulated on six sides by separate polymer layers.

35 USC §103(a) Rejection Of Claim 262 Over Wakabayashi, Bertin et al., Ferguson et al.
And Kinsman et al.

Claim 262 recites materials for the die contacts. Kinsman et al. was cited as disclosing these materials.

The 35 USC §103(a) rejections of claim 262 over Wakabayahsi, Bertin et al., Ferguson et al. and Kinsman et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170.

35 USC §103(a) Rejection Of Claim 269 Over Wakabayashi, Bertin et al., Ferguson et al. And Lin

Claim 269 recites "the die is contained on a semiconductor wafer having a polymer support dam proximate to edges thereof". Lin was cited as disclosing a polymer support dam.

The 35 USC §103(a) rejection of claim 269 over Wakabayashi, Bertin et al., Ferguson et al. and Lin is traversed for essentially the same reasons discussed above with respect to independent claim 170.

These rejections are further traversed because the claimed component *taken as a whole* is unobvious over the art. Although support dams are known in the art, they have not heretofore been employed in a thinned substrate encapsulated on six sides by separate polymer layer.

35 USC §103(a) Rejection Of Claim 271 Over Wakabayashi, Bertin et al., Ferguson et al. And Wang

Claim 271 recites "the second polymer layer comprises parylene". Wang was cited as disclosing "a semiconductor device that has parylene".

The 35 USC §103(a) rejections of claim 271 over Wakabayashi, Farnworth et al., Bertin et al. and Wang is traversed for essentially the same reasons discussed above with respect to independent claim 170.

35 USC §103(a) Rejections Of Claims 170, 172, 173, 175-178, 263, 265-267 and 270 Over Wakabayashi, Grigg et al. And Ferguson et al.

The 35 USC §103(a) rejections of claims 170, 172, 173, 175-178, 263, 265-267 and 270 over Wakabayashi, Grigg et al. and Ferguson et al. are traversed as the rejected claims *taken as a whole* are unobvious over the cited art *taken as a whole*.

Wakabayashi and Ferguson et al. have been previously cited and discussed.

Grigg et al. was cited as disclosing "a semiconductor device that has a thinned die with a thickness of from 10um to 720 um (For Example: See Column 10 Lines 5-8)".

As previously argued, although thinned substrates are known in the art, the present component is unobvious because the thinned substrate provides new and

unexpected results (a thinner component). Further, the present component requires a patented fabrication method which is not disclosed or enabled by the art.

Also in Grigg et al., a thinned flip chip, rather than an encapsulated component, is disclosed. As shown in Figure 5 of Grigg et al., the structure 10 is not encapsulated on six sides by separate polymer layers as with the present component. Further, the disclosed thickness in Grigg et al. for a bumped component is 6 mils, which is 152.4 μm (column 10, lines 5-7). On the other hand, the present component claims a thickness of from 10 μm to 152 μm , which is less than the flip chip in Grigg et al.

The rejections of claims 170, 172, 173, 175-178, 263, 265-267 and 270 under 35 USC §103(a) are further traversed as one skilled in the art at the time of the invention would have no reason to combine the references in the manner of the Office Action. With regard to the combination of references the Office Action states: "It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include a thinned die with a thickness of from 10 μm to 720 μm as disclosed in Grigg because it aids in enhancing performance (For Example: See Column 1 Lines 30-40)".

Admittedly, reduced size is a primary motivation for advancement in semiconductor manufacture. However, the claimed component requires a patented fabrication process (US Patent No. 6,908,784), which is not disclosed or enabled by the art. Accordingly, the proposed motivation for the combination would not be obvious to one skilled in the art at the time of the invention.

35 USC §103(a) Rejections Of Claims 171 and 268 Over Wakabayashi, Grigg et al., Ferguson et al. and Beffa et al.

Claims 171 and 268 recite that the thinned substrate comprises "a tested and burned in die". Beffa et al. was cited as disclosing a tested and burned in die.

The 35 USC §103(a) rejections of claims 171 and 268 over Wakabayashi, Grigg et al., Ferguson et al. and Beffa et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170.

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Claim 176 recites a ball grid array for the terminal contacts. Farnworth et al. was cited as disclosing a ball grid array.

The 35 USC §103(a) rejections of claim 176 over Wakabayahsi, Grigg et al., Ferguson et al. and Farnworth et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170.

35 USC §103(a) Rejection Of Claim 177 Over Wakabayashi, Grigg et al., Ferguson et al. And Farnworth et al.

Claim 177 recites "the substrate includes conductive vias in electrical communication with the die contacts and the contact bumps".

The 35 USC §103(a) rejections of claim 177 over Wakabayahsi, Grigg et al., Ferguson et al. and Farnworth et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170.

These rejections are further traversed because the claimed component *taken as a whole* is unobvious over the art. Although, conductive vias are known in the art they have not heretofore been employed in a thinned substrate encapsulated on six sides by separate polymer layers.

35 USC §103(a) Rejection Of Claim 262 Over Wakabayashi, Grigg et al., Ferguson et al. And Kinsman et al.

Claim 262 recites materials for the die contacts. Kinsman et al. was cited as disclosing these materials.

The 35 USC §103(a) rejections of claim 262 over Wakabayahsi, Grigg et al., Ferguson et al. and Kinsman et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170.

35 USC §103(a) Rejection Of Claim 269 Over Wakabayashi, Grigg et al., Ferguson et al.
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Claim 269 recites "the die is contained on a semiconductor wafer having a polymer support dam proximate to edges thereof". Lin was cited as disclosing a polymer support dam.

The 35 USC §103(a) rejection of claim 269 over Wakabayashi, Grigg et al., Ferguson et al. and Lin is traversed for essentially the same reasons discussed above with respect to independent claim 170.

These rejections are further traversed because the claimed component *taken as a whole* is unobvious over the art. Although, support dams are known in the art they have not heretofore been employed in a thinned substrate encapsulated on six sides by separate polymer layer.

35 USC §103(a) Rejection Of Claim 271 Over Wakabayashi, Grigg et al., Ferguson et al.
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Claim 271 recites "the second polymer layer comprises parylene". Wang was cited as disclosing "a semiconductor device that has parylene".

The 35 USC §103(a) rejections of claim 271 over Wakabayashi, Grigg et al., Bertin et al. and Wang is traversed for essentially the same reasons discussed above with respect to independent claim 170.

Conclusion

In view of the amendments and arguments, favorable consideration and allowance of claims 170-179 and 262-271 is respectfully requested. An Information Disclosure Statement is being filed concurrently with this Amendment. Should any issues remain, the Examiner is asked to contact the undersigned by telephone.

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